

DIESEL: SUSPENSION AND STEERING

COURSE DESCRIPTION

Diesel: Suspension And Steering is a course offering training in the diagnosis and repair of the steering and suspension systems of medium and heavy trucks. Students learn the principles of suspension/steering systems and suspension alignment. The course provides the student with training in wheel alignment and the testing, diagnosis, and repair of steering and suspension systems. Course content prepares students for entry level employment in diesel suspension and steering, continuing education in diesel technology and post secondary education. Student completing the *Diesel: Suspension and Steering* course will be eligible to take the ASE written examination for Suspension and Steering in Medium/Heavy Trucks.

Prerequisite(s):

Transportation Core

Algebra I or Math for Technology II; Physical Science or Principles of Technology I (may be concurrent)

Requirement:

A minimum of 90 hours must be dedicated to diesel suspension and steering systems to meet minimum standards set by NATEF.

Recommended Credits:

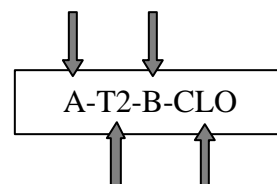
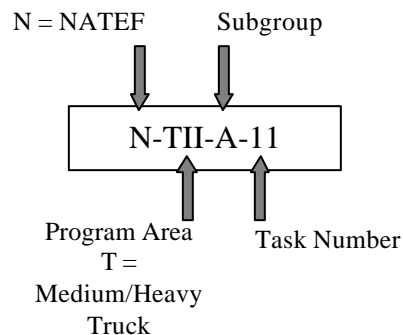
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Recommended Grade Level(s):

11th or 12th

Notes:

Course is aligned with NATEF tasks list for medium/heavy trucks. Items have been organized based on the requirements of the Tennessee required course description format. NATEF tasks are referenced with the corresponding Performance Standards. Additional cognitive objectives covered by the AYES curriculum are also referenced. Codes are as follows:



DIESEL: SUSPENSION AND STEERING STANDARDS
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- 1.0 Students will demonstrate leadership, citizenship, and teamwork skills required for success in the school, community, and workplace.
- 2.0 Students will demonstrate diesel technology safety practices, including Occupational Safety and Health Administration (OSHA) and Environmental Protection Agency (EPA) requirements for a diesel repair facility.
- 3.0 Students will properly test, diagnose, and repair steering systems.
- 4.0 Students will properly test, diagnose, and repair suspension systems.
- 5.0 Students will properly diagnose and repair wheel alignment problems.
- 6.0 Students will properly diagnose and repair wheels and tires.
- 7.0 Students will properly service and repair truck frames.
- 8.0 Students will demonstrate communication skills required in the diesel service industry.
- 9.0 Students will demonstrate interpersonal and employability skills required in the diesel service industry.

DIESEL: SUSPENSION AND STEERING

STANDARD 1.0

Students will demonstrate leadership, citizenship, and teamwork skills required for success in the school, community, and workplace.

The student will:

- 1.1 Develop a plan for self-improvement.
- 1.2 Participate in SkillsUSA-VICA as an integral part of classroom instruction.
- 1.3 Assess client expectations.
- 1.4 Develop a working relationship with a mentor.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

- 1.1 Recognizes stress factors.
- 1.2.A Applies the points of the creed to personal and professional situations.
- 1.2.B Reviews professional journals and develops a 3 to 5 minute presentation.
- 1.3.A Develops a customer satisfaction card and implements a plan to gather information from responses.
- 1.4.A Develops a schedule to provide time to work with a mentor.
- 1.4.B Keeps a record of time and activities performed while working with a mentor.

SAMPLE PERFORMANCE TASKS

- Create a leadership inventory and use it to conduct a personal assessment to identify stress factors or sources.
- Participate in various SkillsUSA-VICA programs and/or competitive events.
- Measure and modify short-term goals.
- Implement an annual program of work.
- Identify a mentor and establish a relationship with the mentor. Develop a plan using time management skills to spend time with the mentor. Job shadow or internship experiences should be developed and recorded.

INTEGRATION LINKAGES

SkillsUSA-VICA, *Professional Development Program*, SkillsUSA-VICA, Communications and Writing Skills, Teambuilding Skills, Research, Language Arts, Sociology, Psychology, Math, Math for Technology, Applied Communications, Social Studies, Problem Solving, Interpersonal Skills, Employability Skills, Critical-Thinking Skills, SCANS (Secretary's Commission on Achieving Necessary Skills), Chamber of Commerce, Colleges, Universities, Technology Centers, and Employment Agencies

DIESEL: SUSPENSION AND STEERING

STANDARD 2.0

Students will demonstrate diesel technology safety practices, including Occupational Safety and Health Administration (OSHA) and Environmental Protection Agency (EPA) requirements for a diesel repair facility.

LEARNING EXPECTATIONS

The student will:

- 2.1 Determine the safe and correct use of equipment used in a diesel repair facility for suspension and steering servicing.
- 2.2 Use protective clothing, eye, and ear safety equipment.
- 2.3 Use fire protection equipment.
- 2.4 Follow OSHA and EPA regulations affecting suspension and steering diesel service technology.
- 2.5 Respond to safety communications relating to suspension and steering diesel service technology.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

- 2.1.A Conforms to federal, state, local regulations, and manufacturer's directions when handling, storing, and disposing of chemicals.
- 2.1.B Ensures proper use of equipment used in suspension and steering servicing.
- 2.1.C Locates first aid supplies.
- 2.2.A Demonstrates proper usage of special safety equipment used in suspension and steering servicing.
- 2.2.B Selects and uses the appropriate protective clothing for a given task.
- 2.2.C Demonstrates the use of eye and ear protection.
- 2.3.A Distinguishes the proper fire extinguisher for each class of fire.
- 2.3.B Demonstrates the proper use of a fire extinguisher.
- 2.4.A Locates regulatory information.
- 2.4.B Extracts information from Material Safety Data Sheets.
- 2.4.C Complies with relevant regulations and standards relating to suspension and steering servicing.
- 2.4.D Passes with 100% accuracy a written examination relating specifically to suspension and steering safety issues.
- 2.4.E Passes with 100% accuracy a performance examination relating specifically to suspension and steering tools and equipment.
- 2.4.F Maintains a portfolio record of written safety examinations and equipment examinations for which the student has passed an operational checkout by the instructor.
- 2.5.A Interprets and takes action to safety communications and recalls from manufacturers pertaining to suspension and steering.
- 2.5.B Complies with safety signs and symbols.

SAMPLE PERFORMANCE TASKS

- Assess the work area for safety hazards.
- Design a corrections program for identified hazards.
- Model the appropriate protective equipment for an assigned task.

INTEGRATION LINKAGES

Science, Math, Math for Technology, Technology Literacy, Applied Communications, Problem-Solving, National Institute for Automotive Service Excellence (ASE), National Automotive Technician Education Foundation (NATEF), Occupational Safety and Health Administration (OSHA), Environmental Protection Agency (EPA), SkillsUSA-VICA, Secretary's Commission on Achieving Necessary Skills (SCANS)

DIESEL: SUSPENSION AND STEERING

STANDARD 3.0

Students will properly inspect, diagnose, and repair steering systems.

LEARNING EXPECTATIONS

The student will:

- 3.1 Analyze the function and operation of medium and heavy truck steering systems.
- 3.2 Inspect, diagnose, repair or adjust steering column components.
- 3.3 Inspect, diagnose, service, repair or replace steering unit components.
- 3.4 Inspect, adjust, service, or replace steering linkage components.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

- 3.1.A Assesses the characteristics of liquids.
- 3.1.B Correlates the following concepts with their role in steering or suspension systems:
 - force
 - lever
 - gear ratios
 - reduction
 - overdrive
 - friction
 - inertia
 - momentum
 - speed
 - work
 - torque
 - power
- 3.1.C Distinguishes the components of medium and heavy-duty truck steering linkage and illustrates their operation.
- 3.1.D Interprets the fundamental laws of hydraulics and concludes how they apply to the operation of a power steering pump and power steering gears.
- 3.1.E Distinguishes the components of the following systems and illustrates system operation:
 - integral non-rack and pinion power steering gear,
 - TRW/Ross steering system, and
 - an electronically controlled automotive steering system.
- 3.2.A Diagnoses fixed and driver adjustable steering column and shaft noise, looseness, and binding problems; determines needed action.
- 3.2.B Inspects steering shaft U-joints, slip joints, bearings, bushings, and seals; phases shaft U-joints; determines needed action.
- 3.2.C Checks and adjusts cab mounting and ride height.
- 3.2.D Centers the steering wheel.
- 3.2.E Disables and enables supplemental restraint system (SRS) in accordance with manufacturer's procedures.
- 3.3.A Diagnoses power steering system noise, steering binding, darting/oversteer, reduced wheel cut, steering wheel kick, pulling, non-recovery, turning effort, looseness, hard steering, overheating, fluid leakage, and fluid aeration problems; determines needed action.
- 3.3.B Determines recommended type of power steering fluid; checks level and condition; determines needed action.
- 3.3.C Flushes and refills power steering system; purges air from system.

- 3.3.D Performs power steering system pressure, temperature, and flow tests; determines needed action.
- 3.3.E Inspects and adjusts, services, repairs or replaces the following:
 - power steering pump drive gear and coupling.
 - power steering pump, mountings, and brackets.
 - power steering system cooler, lines, hoses, clamps/mountings, hose routings, and fittings.
 - linkage-assist type power steering cylinder or gear (dual system).
 - integral type power steering gear.
 - power steering pump belt(s) and pulley(s).
 - power steering reservoir, including filter, seals, and gaskets.
- 3.3.F Adjusts manual and automatic steering gear poppet/relief valves.
- 3.4.A Inspects the following and adjusts, positions, or replaces as needed:
 - pitman arm.
 - drag link (relay rod) and tie rod ends (ball and adjustable socket type).
 - steering arm and levers, and linkage pivot joints.
 - idler arm, bearings, and bushings.
 - clamps and retainers on cross tube/relay rod/centerlink/tie rod.
- 3.4.B Checks and adjusts wheel stops.
- 3.4.C Lubricates steering linkage joints as needed.

SAMPLE PERFORMANCE TASKS

- Flush and replace power fluid steering on a vehicle and replace with correct type of fluid.
- Diagnose problem with steering column and perform indicated action.
- Using case scenarios, follow strategy-based diagnostic procedure to verify the complaint, define the problem, isolate the problem, validate the problem, make the repair, and test the repair. Complete a repair order using technical writing skills and calculate salary earnings based on the repair order description and manufacture allowances for each item on the work order. Calculate manufacturer labor operation time used in the diagnostic process.

INTEGRATION LINKAGES

Science, Math, Math for Technology, Technology Literacy, Applied Communications, Problem-Solving, National Institute for Automotive Service Excellence (ASE), National Automotive Technician Education Foundation (NATEF), Occupational Safety and Health Administration (OSHA), Environmental Protection Agency (EPA), SkillsUSA-VICA, Secretary's Commission on Achieving Necessary Skills (SCANS)

DIESEL: SUSPENSION AND STEERING

STANDARD 4.0

Students will properly test, diagnose, and repair suspension systems.

LEARNING EXPECTATIONS

The student will:

- 4.1 Analyze the function and operation of truck suspension systems.
- 4.2 Inspect, diagnose, repair or replace front and rear suspension systems and components.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

- 4.1.A Compares and contrasts the different types of front and rear truck suspensions and illustrates their operation.
- 4.1.B Examines the function of springs and Hooke's law.
- 4.1.C Illustrates shock absorber operation and ratios and wheel jounce and rebound.
- 4.1.D Compares and contrasts the different types of wheel bearings and their operation.
- 4.1.E Compares and contrasts the different types of medium/heavy-duty truck air suspensions and their operation.
- 4.1.F Compares and contrasts the different types of tandem axle rear truck suspensions and their operation and components.
- 4.2.A Inspects the following and adjusts, services, repairs or replaces as needed:
 - front axles, U-bolts, and nuts.
 - leaf springs, center bolts, clips, eye bolts and bushings, shackles, slippers, insulators, brackets, and mounts.
 - torque arms, bushings, and mounts.
 - axle aligning devices such as radius rods, track bars, stabilizer bars, and related bushings, mounts, shims, and cams.
 - service king pin, steering knuckle bushings, locks, bearings, seals, and covers.
 - shock absorbers, bushings, brackets, and mounts.
 - walking beams, center (cross) tube, bushings, mounts, load pads, and saddles/caps.
- 4.2.B Inspects and tests air suspension pressure regulator and height control valves, lines, hoses, dump valves, and fittings; adjusts, repairs or replaces as needed.
- 4.2.C Inspects and tests air springs, mounting plates, springs, suspension arms, and bushings; replaces as needed.
- 4.2.D Measures vehicle frame angle (ride height) and determines needed action.
- 4.2.E Diagnoses rough ride problems and determines needed action.

SAMPLE PERFORMANCE TASKS

- Inspect a vehicle suspension system and determine any needed repairs to components.
- Diagram the operation of the front suspension system.
- Choose proper tool to perform needed repair.
- Using case scenarios, follow strategy-based diagnostic procedure to verify the complaint, define the problem, isolate the problem, validate the problem, make the repair, and test the

repair. Complete a repair order using technical writing skills and calculate salary earnings based on the repair order description and manufacture allowances for each item on the work order. Calculate manufacturer labor operation time used in the diagnostic process.

INTEGRATION LINKAGES

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DIESEL: SUSPENSION AND STEERING

STANDARD 5.0

Students will properly diagnose and repair wheel alignment problems.

LEARNING EXPECTATIONS

The student will:

- 5.1 Analyze the elements of medium/heavy truck wheel alignment.
- 5.2 Check, diagnose, and adjust or repair wheel alignment and related components.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

- 5.1.A Correlates the terms caster, camber, thrust angle, and toe-in (turning radius) with wheels, steering, and tires.
- 5.1.B Illustrates steering axis inclination.
- 5.1.C Correlates the terms included angle, turning radius, and toe-out on turns with steering geometry.
- 5.2.A Chooses the appropriate types of measurement to measure caster, camber, wheel toe, steering axis inclination (SAI), and turning radius (toe-out on turns, Ackerman angle); determines needed adjustments or repairs.
- 5.2.B Diagnoses vehicle wandering, pulling, shimmy, and hard steering problem(s); adjusts and repairs as needed.
- 5.2.C Checks camber and KPI/SAI (king pin inclination/steering axis inclination); determines needed action.
- 5.2.D Checks the following and adjusts or repairs as needed:
 - caster
 - toe
 - rear axle(s) alignment (thrustline/centerline) and tracking
 - front axle alignment (centerline)
- 5.2.E Diagnoses turning/Ackerman angle (toe-out-on-turns) problems; determines needed action.

SAMPLE PERFORMANCE TASKS

- Diagnose driver complaint by using strategy based diagnostic procedure about steering and make appropriate adjustment or repair.
- Use computerized and manual four-wheel alignment equipment to measure caster, camber, wheel toe, SAI, and turning radius.
- Using case scenarios, follow strategy-based diagnostic procedure to verify the complaint, define the problem, isolate the problem, validate the problem, make the repair, and test the repair. Complete a repair order using technical writing skills and calculate salary earnings based on the repair order description and manufacture allowances for each item on the work order. Calculate manufacturer labor operation time used in the diagnostic process.

INTEGRATION LINKAGES

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DIESEL: SUSPENSION AND STEERING

STANDARD 6.0

Students will properly diagnose and repair wheels and tires.

LEARNING EXPECTATIONS

The student will:

- 6.1 Analyze the operation of wheels and tires.
- 6.2 Diagnose and repair or replace wheels and tires.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

- 6.1.A Correlates the terms static balance, dynamic balance, tramping, and radial force variation with wheels and tires.
- 6.1.B Differentiates between dynamic and static wheel balance.
- 6.1.C Determines the basic characteristics of the medium/heavy truck tire and compares the basic types of tire construction.
- 6.1.D Examines the types of tire ratings to include tire size ratings and spare tires.
- 6.1.E Illustrates wheel rim design.
- 6.2.A Chooses the appropriate types of measurement to measure wheel, tire, axle, and hub runout; determines needed repairs.
- 6.2.B Diagnoses unusual tire wear patterns, check tread depth, and mismatched tread design; determines needed action.
- 6.2.C Diagnoses wheel/tire vibration, shimmy, pounding, and hop (tramp) problems; determines needed action.

SAMPLE PERFORMANCE TASKS

- Diagnose a tire problem based on observation of unusual tire wear.
- Interpret a tire rating.
- Using case scenarios, follow strategy-based diagnostic procedure to verify the complaint, define the problem, isolate the problem, validate the problem, make the repair, and test the repair. Complete a repair order using technical writing skills and calculate salary earnings based on the repair order description and manufacture allowances for each item on the work order. Calculate manufacturer labor operation time used in the diagnostic process.

INTEGRATION LINKAGES

Science, Math, Math for Technology, Technology Literacy, Applied Communications, Problem-Solving, National Institute for Automotive Service Excellence (ASE), National Automotive Technician Education Foundation (NATEF), Occupational Safety and Health Administration (OSHA), Environmental Protection Agency (EPA), SkillsUSA-VICA, Secretary's Commission on Achieving Necessary Skills (SCANS)

DIESEL: SUSPENSION AND STEERING

STANDARD 7.0

Students will properly service and repair truck frames.

LEARNING EXPECTATIONS

The student will:

- 7.1 Examine the characteristics of truck frames.
- 7.2 Determine the function and operation of fifth wheels.
- 7.3 Couple a truck and tractor.
- 7.4 Service and repair truck frame.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

- 7.1.A Relates section modulus to truck frames.
- 7.1.B Determines the yield strength of a truck frame.
- 7.1.C Relates resisting bending moment, applied moment, and bending moment to truck frames.
- 7.1.D Illustrates the design of a C-channel truck frame.
- 7.1.E Compares the different types of frame reinforcements.
- 7.1.F Distinguishes six different defective frame conditions.
- 7.2.A Explores the purpose of a fifth wheel.
- 7.2.B Compares the seven types of fifth wheels and their applications.
- 7.2.C Illustrates the operation of a sliding fifth wheel.
- 7.2.D Assesses the advantages of a sliding fifth wheel.
- 7.2.E Illustrates the operation of a fifth wheel with a yoke and secondary lock during the coupling and uncoupling processes.
- 7.3.A Illustrates the proper procedure for coupling a tractor and trailer.
- 7.3.B Illustrates the proper procedure for uncoupling a tractor and trailer.
- 7.4.A Follows necessary safety precautions for working on truck frames.
- 7.4.B Inspects and adjusts fifth wheel, pivot pins, bushings, locking jaw mechanisms, and mounting bolts; determines needed action.
- 7.4.C Inspects sliding fifth wheel, tracks, stops, locking systems, air cylinders, springs, lines, hoses, and controls.
- 7.4.D Inspects frame and frame members for cracks, breaks, distortion, elongated holes, looseness, and damage; determines needed repairs.
- 7.4.E Inspects, installs, and repairs frame hangers, brackets, and cross members following manufacturer's recommended procedures.
- 7.4.F Inspects, installs, and repairs or replaces pintle hooks and draw bars.

SAMPLE PERFORMANCE TASKS

- Identify a defective frame condition.
- Determine manufacturer's recommended procedures for installing frame hangers.
- Using case scenarios, follow strategy-based diagnostic procedure to verify the complaint, define the problem, isolate the problem, validate the problem, make the repair, and test the repair. Complete a repair order using technical writing skills and calculate salary earnings based on the repair order description and manufacture allowances for each item on the work order. Calculate manufacturer labor operation time used in the diagnostic process.

INTEGRATION LINKAGES

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DIESEL: SUSPENSION AND STEERING

STANDARD 8.0

Students will demonstrate communication skills required in the diesel service industry.

LEARNING EXPECTATIONS

The student will:

- 8.1 Communicate and comprehend oral and written information typically occurring in diesel suspension and steering diagnosis and repair.
- 8.2 Solve suspension and steering problems and make decisions using a logical process.
- 8.3 Use teamwork skills to accomplish goals, solve problems, and manage conflict within groups.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

- 8.1.A Interprets and uses written information in common job formats, such as tables, charts, and reference materials and manuals pertaining to suspension and steering systems.
- 8.1.B Interprets and uses graphical information such as blueprints, electrical schematics, process control schematics, automotive flow charts, and other diesel technology diagrams related to suspension and steering.
- 8.1.C Uses electronic resources to obtain service and other diesel technology information.
- 8.1.D Analyzes information obtained from various sources to determine a diagnostic approach.
- 8.1.E Communicates clearly and appropriately in oral and written form.
- 8.1.F Interprets a repair order.
- 8.2.A Develops a hypothesis regarding the cause of a suspension and steering problem.
- 8.2.B Tests the hypothesis to determine the solution to the suspension and steering problem.
- 8.2.C Creates, evaluates, and revises as needed a plan to resolve a problem.
- 8.2.D Completes strategy based diagnostic procedure to verify the complaint, define the problem, isolate the problem, validate the problem, make the repair, and test the repair pertaining to suspension and steering systems.
- 8.3.A Serves in each of the functional roles of a team performing suspension and steering servicing.
- 8.3.B Contrasts ethical and unethical workplace behaviors.
- 8.3.C Demonstrates appropriate and positive examples of giving and accepting criticism.
- 8.3.D Modifies behavior or revises work based on appropriate criticism.
- 8.3.E Manages a team and evaluates others.
- 8.3.F Evaluates the role of the repair team within the organizational system of a dealership or fleet shop.

SAMPLE PERFORMANCE TASKS

- Complete a repair order.
- Use reference materials to determine procedures for steering or suspension diagnosis or repair.
- Work as a team member to develop a diagnostic strategy.
- Use blueprints and diagrams to execute a task.

INTEGRATION LINKAGES

Communication Skills, Teamwork Skills, Computer Skills, Reading and Writing Skills, Language Arts, Problem Solving, Interpersonal Skills, Employability Skills, Critical-Thinking Skills, National Institute for Automotive Service Excellence, National Automotive Technician Education Foundation, Occupational Safety and Health Administration (OSHA), Environmental Protection Agency (EPA), SkillsUSA-VICA, Secretary's Commission on Achieving Necessary Skills (SCANS)

DIESEL: SUSPENSION AND STEERING

STANDARD 9.0

Students will demonstrate interpersonal and employability skills required in the diesel service industry.

LEARNING EXPECTATIONS

The student will:

- 9.1 Infer relationships between work ethics and organizational and personal job success.
- 9.2 Develop customer service skills.
- 9.3 Maintain a neat and orderly work area.
- 9.4 Assess implications of diversity for communities and workplaces and various manufacturers.
- 9.5 Explore supervisory and management roles in dealerships and fleetshops.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:

- 9.1.A Assesses the potential impact of an individual's positive work ethic and an individual's negative work ethic on an organizational system.
- 9.1.B Infers the relationship between work ethics and personal job success.
- 9.2.A Maximizes customer service opportunities.
- 9.2.B Demonstrates improvement in customer service skills.
- 9.3.A Keeps work area and tools organized and free from clutter.
- 9.3.B Cleans work area and suspension and steering related equipment according to NATEF and EPA standards.
- 9.3.C Deduces the correlation between a clean orderly work environment and successful and efficient job performance.
- 9.4.A Points out benefits and problems that may arise from diversity in suspension and steering in various manufacturers.
- 9.4.B Engages in team negotiation activities.
- 9.5.A Determines personal proficiency in employability behavior competencies.
- 9.5.B Demonstrates personal proficiency in management skill competencies.
- 9.5.C Assesses the benefits of incorporating time management principles into work in the diesel technology service industry.

SAMPLE PERFORMANCE TASKS

- Maintain an orderly work area.
- Participate in a problem-solving team.
- Consistently arrive at class on time.
- Participate in an internship.
- Resolve an interpersonal conflict in the classroom.

INTEGRATION LINKAGES

Science, Math, Math for Technology, Technology Literacy, Applied Communications, Problem-Solving, National Institute for Automotive Service Excellence (ASE), National Automotive Technician Education Foundation (NATEF), Occupational Safety and Health Administration (OSHA), Environmental Protection Agency (EPA), SkillsUSA-VICA, Secretary's Commission on Achieving Necessary Skills (SCANS)

DIESEL: SUSPENSION AND STEERING

SAMPLING OF AVAILABLE RESOURCES

T5 Suspension and Steering Curriculum Module, AYES Corporation, www.ayes.org

2001 Medium/Heavy Duty Truck Task List, National Automotive Technicians Education Foundation (NATEF), www.natef.org

Diesel Technology: Workplace Skills, Instructional Materials Laboratory (IML), University of Missouri

Diesel Technology: Safety Skills, Instructional Materials Laboratory (IML), University of Missouri

Curriculum Integrator, CORD Communications, Waco, Texas 76798

Diesel Technology, Goodheart-Willcox, 2001.